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NODULAR-BEARING SCHISTS NEAR PEARL, COLORADO.[1]

THE central area of the Pearl district consists of schistose rocks which are cut by numerous dikes of coarse pegmatite, varying from two to forty feet in width, and having a general northwesterly and southeasterly strike. Numerous copper prospects are being developed upon these, and in several instances bodies of copper ore have been discovered. Associated also are veins of quartz, which are of great interest because of the fine crystals of spinel, of the variety ceylonite, which they contain. Octahedra of from 5 to 25^{mm} in diameter are found in large quantity. That which makes them especially interesting is the fact that all the crystals contain quartz inclusions in the greatest abundance, often to such an extent as considerably to lower their specific gravity. The spinel occurs in portions of the dikes which are almost wholly quartz. The included quartz appears to be identical with that surrounding the spinel. It would seem, therefore, that part of the quartz had crystallized out before the formation of the spinel, and the remainder followed the crystallization of the spinel. In other words, we have two generations of quartz crystals, the first generation being partly included in the spinel.

To the southwest of this lies another area of schistose rocks which are cut by dark basic dikes. These dikes are mineralized, and upon them prospects are also being opened up. They are an example of what the average miner firmly believes to be always the case — increase of value in depth. At the surface they show little sign of mineralization, but upon sinking chalcopyrite appears in considerable quantity, and seems to have been original with the dike matter, as the dike is perfectly fresh and shows no sign of mineralizing action. If the chalcopyrite was original with the dike matter, why it appears in depth and not at the surface is a question that I am not prepared to answer.

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[1] The recently opened mining town of Pearl is situated in Larimer county, Colo., about two miles south of the state line between Colorado and Wyoming, and at an elevation of about 8,400 feet (barometric).

Between these areas is a band of biotite schist which presents an unusually fine example of the stringing out and plication of quartz lenses. At times a single lens will have been squeezed to a band scarcely an inch thick and folded on itself from a dozen to twenty times, the folds being several inches to several feet long and sometimes only a fraction of an inch across. The white quartz against the dark background of the schist presents a most striking appearance. This is shown by the accompanying photograph (Fig. 1). The size of the specimen can be judged from the volume of the *Neues Jahrbuch* which is used to prop it up. In a width of about six inches we have twelve folds, so that the same band appears twenty-four times. It seems most probable that in this case the quartz must have existed as a vein in the rock before its metamorphism, and the oscillations which took place during the metamorphic processes have produced

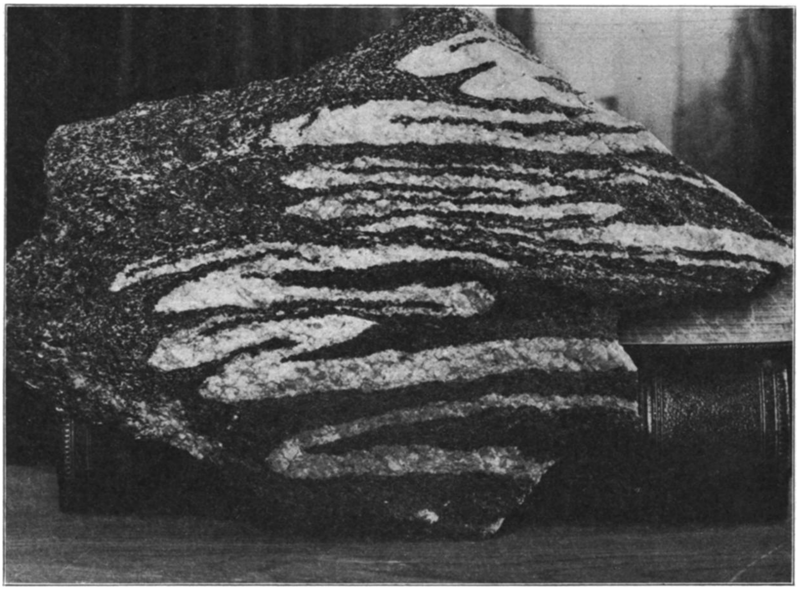

FIG. 1.—Plication of quartz vein in schist.

this interesting effect. It is to be noticed that, in general, the thicker portions are on the same phase of the fold.

The occurrence of the greatest interest lies in the second area mentioned above. This is a belt of schist about one hundred feet wide, full of ellipsoidal nodules which vary in length from one to four inches along the greatest axis. As they are harder than the schist, they weather out in relief, and immediately suggest to the beholder the "prune granite" of Quincy, Mass., excepting that the "prunes" are in this case lighter in color than the rock mass. The accompanying photograph of specimens of the rock will afford an idea of their appearance (Fig. 2).

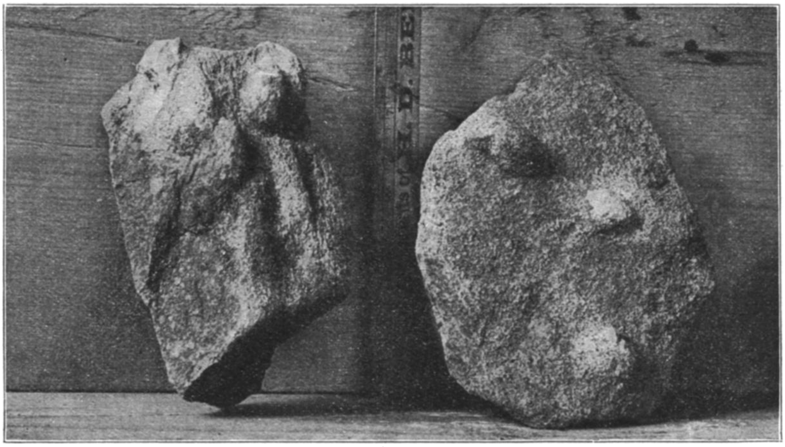

FIG. 2.—Iolite schist, showing projecting nodules.

Upon microscopic examination these nodules prove of unusual interest, because they largely consist of, or have been derived from, a mineral which has had very little notice in North American petrography, namely, iolite. Except as an accessory in certain basic rocks in Minnesota and as a mineralogical occurrence in various localities in the East, it has scarcely been mentioned. Abroad, however, it has frequently been described.[1]

Only surface material was available for study, and in this the iolite, as is usually the case, is much altered, the common alteration products of pinite and other secondary minerals having replaced it to a considerable extent. In most cases, however, what Dana describes as the first stage in the alteration of iolite has taken place—namely, the division of the iolite prisms into plates parallel to the base, and the development of a pearly luster on the plates. This pearly luster is especially prominent, and at first glance would deceive one into believing that the mineral is muscovite. The hardness and brittleness of the plates quickly dispel that illusion, however. It is interesting to note that, usually, a nodule displays this luster equally all over its surface at the same angle of illumination, showing that the crystallographic axes coincide throughout the mass, as though it were originally a single crystal.

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[1] *Vide Zeit. für Kryst.*, Vol. XXIX, p. 305; also Vol. XXXI, p. 248; *Neues Jahrbuch*, Vol. XI (1899), p. 84; *Bull. de la Soc. de Sc. Boucarest, Roumanie*, Vol. III.

In the hand specimen the nodule appears practically homogeneous, but in thin section, in addition to the iolite and alteration products, grains of quartz appear. How much quartz is present cannot be readily determined, for where the interference figures cannot be obtained quartz and iolite are indistinguishable, except by microchemical tests. I do not think the amount is large, however. The iolite shows its characteristic pleochroic halos, and often contains inclusions whose nature could not be determined.

The ground-mass of the schist is ordinary muscovite-biotite schist, the two micas being about equal in amount. It seems extremely probable that the muscovite has resulted from the alteration of grains of iolite scattered throughout the rock mass, as it is slightly more brittle than the ordinary muscovite.

The origin of the iolite, and, more especially, the origin of the nodules, is a question that could not be answered without further study of the region and also of the rock.

Three miles northeast of Pearl, in Wyoming, and apparently diametrically across the pegmatite area from the iolite schist, is another interesting belt containing veins of argentiferous lead and zinc ores. It is a schist resembling in a general way that in which the iolite occurs, and it, too, is full of nodules. These are irregularly prismatic in shape, differing from the iolite nodules in that respect. Further, they consist entirely of quartz which is full of rutile needles to an unusual extent. The needles seem to be arranged in approximately parallel positions, and are so numerous that they create false lines of cleavage in the quartz, it cleaving readily in one direction and with more difficulty at approximately right angles to this. The sagenitic structure common to rutile needles when they occur in quartz in large amount does not appear to be anywhere present.

The occurrence of the two schists in such proximity, and both containing nodular segregations, would lead one to suspect that there must be some connection between them. Speculation upon it with present data is useless, however. After further study features of great geologic interest may be discovered.

In concluding I wish to thank Dr. W. C. Knight for the notes and specimens put by him at the disposal of the writer.

THOMAS T. READ.

DEPARTMENT OF GEOLOGY,
University of Wyoming, Laramie.